USING ULTRASOUND IN BOVINE PRACTICE

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Lake Superior

Wisconsin

Lake Michigan

My smallest dairy  25 cows
Lecture Goals
1) Understand how ultrasound images are generated
2) Use images/video to understand ultrasound advantages over palpation
3) Use images/video to learn how various structures should look

Wet Lab Goals
• Apply lecture principles to real cows
• Try several machines
• Talk to vendors
• Have fun!
ULTRASOUND USE BY AMERICAN BOVINE VETERINARIANS

- 23% use ultrasound
- 77% always palpate
- Average fee for ultrasound: $3.45
- Average fee for palpation: $2.25

Survey by Loren Warnick, DVM, PhD, Cornell University, 2004, n=522

THE THREE MINUTE GUIDE TO THE PHYSICS OF ULTRASOUND

Courtesy of Richard Soutar, Winfield Medical Systems

**Radiographs**
- Air yields contrast and improves imaging
- Fluid obscures organs from view
- The image seen is a view through all layers of the object. Fluid and denser tissues obscure other tissues
- Imaging is static

**Ultrasound**
- Air is an acoustic barrier
- Fluid provides contrast and improves imaging
- The image seen is a very thin 2-dimensional cross section through the tissue. Tissues are not obscured
- Imaging is dynamic
Crystals in the probe head send sound waves into tissues and receive waves that bounce back from tissues.

O.J. Ginther, “Ultrasonic Imaging and Reproductive Events”
Echogenicity

• Clear fluid is non-echogenic or anechoic. The ultrasound waves pass completely through. Clear fluid appears black.
• Very dense tissues like bone and the genital tubercle are highly echogenic or hyperechoic. The ultrasound waves are mostly “echoed” back to the transducer. These tissues appear white.
• Other tissues vary in degrees of echogenicity. They appear various shades of gray depending on density.
**Frequency** =

- cycles per second or Hertz.

3.5MHz: Carcass, deep abdominal.

7.5MHz: Ovaries and very early pregnancies. Tendons.

5MHz: All reproductive exams. Superficial masses or abdominal exams. Most versatile.

**Probe Types**

- Linear probes have multiple crystals that fire downward from the probe face and produce a rectangular image.

- Sector probes have one rotating crystal that fires from the probe tip producing a pie-shaped image.
Linear Probe

Things at the tip of the probe will show up either on the right or left of the screen depending on setting (in this case the tip is on the left).

Things near the face of the probe show up at the top of the screen.

PROBE ORIENTATION
Ultrasound Principles

OJ Ginther, PhD, DVM

Scanning Technique

University of Montreal
CD ROM
ULTRASOUND = MORE UNITS OF USEABLE INFORMATION

Pregnancy vs. Open
25 days vs. 30+

Pregnancy vs. Open
25 days vs. 30+
Accuracy of Ultrasound - Cows

Accuracy of Ultrasound - Heifers

<table>
<thead>
<tr>
<th></th>
<th>Ultrasound</th>
<th>Palpation</th>
<th>Biopryn</th>
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<tbody>
<tr>
<td>Preg/open dx</td>
<td>27+ days</td>
<td>34+ days</td>
<td>30+days, &gt;90 DIM</td>
</tr>
<tr>
<td>Viability</td>
<td>Yes</td>
<td>No</td>
<td>Maybe</td>
</tr>
<tr>
<td>Twins</td>
<td>Yes</td>
<td>Maybe</td>
<td>No</td>
</tr>
<tr>
<td>Gender</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ovaries</td>
<td>Accurate</td>
<td>Inaccurate</td>
<td>No</td>
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</table>
New Methods for Early Pregnancy Diagnosis in Dairy Cattle

Paul Fricke, PhD
University of Wisconsin

EMBRYONIC and FETAL DEATH

Pregnancy Loss in Lactating Dairy Cows

n = 512 breedings; 480 calvings
Total loss (d28 to calving) = 24.7%

Vasconcelos et al., 1997  slide courtesy of Paul Fricke, PhD
Cardinal signs of fetal death

- Lack of heartbeat
- No movement (>60 days)
- Cloudy amnionic or allantoic sac (<60 days)
- Severe separation of chorioallantoic membrane (<60 days)

Signs of fetal distress

- Heartbeat less than 130bpm
- Mild separation of chorioallantoic membrane (<60 days)
- Fetus smaller than expected for age
- Fetal abnormalities
TWIN DIAGNOSIS

Check ovaries

50% of pregnant cows with double ovulations had twins (Thatcher)

Monozygous twins are rare – 4.7% (Fricke)
Look for a “twin line”

Notice the sharing of the chorioallantois and some of its circulation.

Dr. Maarten Drost
Recheck after 60 days

Day 36/42 to day 90: 8% loss of bilateral twins, 32% loss of unilateral twins, 6.2% reduction (Lopez-Gatius)
Abortion distribution, unilateral

Abortion distribution, bilateral

Arturo Scheidegger
Correlation of Milk Production and Twins in 20,000 Cows

Correlation of Milk Production and Twins in One Herd

HIGH RISK PREGNANCIES
Ovaries
(photos courtesy of Dr. Maarten Drost)
Importance of CL at G1

CL at G1, 38 day preg rates
ovulation: 42.2
no ovulation: 37.7

No CL at G1, 38 day preg rates
ovulation: 27.7
no ovulation: 15.4


Is the presence of a CL more important than ovulation at first G1??
CL Diagnosis

Ultrasound with >22mm cut-off size for CL at 24 days post-AI for progesterone >1ng/ml

- Sensitivity 89.5%
- Specificity 89.4%

Palpation to identify CL producing >1ng/ml progesterone (three palpators)

- Sensitivity 33.3-60%
- Specificity 77-93%


IMPORTANCE (OR LACK) OF CYSTIC STRUCTURE

Jeff Stevenson, Hoards’s Dairyman, 2006

584 cows examined by palpation, 51 found with cystic structures (8.7%)
- 19 had cyst with CL
- 12 had cyst with no CL but ovulated after GNRH
- 14 had moderate to high progesterone – luteal cysts
- Only 6 cows had functional follicular cyst
Metritis vs. Mucous

Pyometra vs. Pregnancy
Mucometra

Image by Dr. Giovanni Gnemmi
Fetal Aging

Crown/rump length

Head length

Head diameter

Fetal length in mm + 18 = fetal age in days (works until about day 50)

Fetal Development (Sandra Curran)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Earliest Mean</th>
<th>Range</th>
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<tbody>
<tr>
<td>Embryo proper</td>
<td>20.3</td>
<td>19-24</td>
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<tr>
<td>Heartbeat</td>
<td>20.9</td>
<td>19-24</td>
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<tr>
<td>Allantois</td>
<td>23.2</td>
<td>22-25</td>
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<tr>
<td>Spinal cord</td>
<td>29.1</td>
<td>26-33</td>
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<tr>
<td>Forelimb buds</td>
<td>29.1</td>
<td>28-31</td>
</tr>
<tr>
<td>Amnion</td>
<td>29.5</td>
<td>28-33</td>
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<tr>
<td>Eye orbit</td>
<td>30.2</td>
<td>29-33</td>
</tr>
<tr>
<td>Hindlimb buds</td>
<td>31.2</td>
<td>30-33</td>
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<tr>
<td>Placentomes</td>
<td>35.2</td>
<td>33-38</td>
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<tr>
<td>Split hooves</td>
<td>44.6</td>
<td>42-49</td>
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<tr>
<td>Fetal movement</td>
<td>44.8</td>
<td>42-50</td>
</tr>
<tr>
<td>Ribs</td>
<td>52.8</td>
<td>51-55</td>
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BOVINE FETAL SEXING

WHY?

• Increase sale value of pregnant females
• Early negotiation of bull contracts
• Dystocia monitoring for heifers
• Assist in culling decisions
• Replacement planning

ACCURACY

• 99% or more accurate
• Difficulties include:
  Larger fetuses
  Uncooperative cows
  Female fetuses
• Keep records
FETAL AGE AND SEXING WORKSHEET
Jill Colloton, DVM
Bovine Services, LLC
715-352-2232

Date: 
Client: 

<table>
<thead>
<tr>
<th>DONOR</th>
<th>REIP</th>
<th>DATE BRED OR FETAL AGE</th>
<th>PREDICTED SEX</th>
<th>COMMENTS</th>
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Research indicates that fetal sexing is 85-95% accurate.

Due to variability in fetal size and gestation length between animals, calving dates may deviate up to one month from fetal age measurements.

Although no research indicates that ultrasound is harmful to the fetus, no warranty is made for fetal viability beyond the date of examination.

No warranty is made on fetal sex determination or fetal aging.

WHAT
• The genital tubercle will become the penis in the male and the clitoris in the female
• The GT appears as a bright white bi-lobed structure in both the male and female
• The GT may appear tri-lobed in older fetuses
• Scrotum and teats may be visualized, but the genital tubercle is the only “cardinal sign” of fetal sex

WHERE
• The GT in the male appears directly behind the umbilical cord
• The GT in the female appears under the tail in the perineal area
WHEN

• 55-90 days in dairy cattle, 55-110 in beef cattle
• 60-80 days is ideal
• Prior to day 55 the genital tubercle may not be fully migrated

• In later gestation the fetus is out of reach or too large to orient properly

• In later gestation the genital tubercle becomes less echogenic

HOW

• Avoid oblique views
• Position the fetus as close to the face of the probe as possible
Start by locating the umbilicus and looking for the male GT directly behind it.

If no male GT is found look for the female GT below the tail.

Bovine Reproductive Ultrasonography
Brad Stroud, DVM
Fetal Sexing DVD

Bovine Fetal Sexing Unedited
By Brad Stroud, DVM

Numbered fetal sexing test with 52 real-time scans.

Available through Bovinevet

DVDs and CD-ROMs

Brad Stroud, DVM
• Bovine Fetal Sexing Unedited DVD
• Bovine Reproductive Ultrasonography DVD
• $95 each through Bovine Services

Paul Carriere, PhD, and Luc DesCoteaux, PhD
• Ultrasonography of the Reproductive System of the Cow CD-ROM.
• $150 through Bovine Services or the University of Montreal